March 2, 1909.

G. A. Boulenger, Esq., F.R.S., Vice-President,
in the Chair.

Mr. R. H. Burne, F.Z.S., exhibited and remarked on the following specimens of certain elastic mechanisms in Fishes and Reptiles:—

"1. The *ligamentum longitudinale ventrale* of a Shad (*Clupea alosa*).

The ligament lies in the cavity of the aorta suspended by a longitudinal fold of its dorsal wall. In front it is firmly attached to the basioccipital; in the trunk region it is free except for the mesentery-like fold of the aortic wall by which it is suspended (text-fig. 20, M., p. 202); and in the tail region it becomes more and more closely attached to the ventral surface of the vertebral column, projecting merely as a ridge into the cavity of the aorta.

The ligament itself is a round or oval band of elastic tissue forming in the trunk region a thickened edge to a longitudinal curtain that divides the cavity of the aorta into two lateral channels.

The ligament is extremely tight, so much so that when the trunk muscles are removed, it draws the vertebral column into a series of lateral serpentine curves. Its strength is also shown by the large size of the elastic ligament between the neural spines.

In the trunk region the aorta is peculiarly spacious, filling a wide channel upon the ventral surface of the vertebral column, bounded by the flat lower surface of the vertebral column above and by a series of quadrangular hæmal arches at the sides and below.

There is little doubt that this ligament is concerned in the propulsion of blood within the aorta. The following explanation of its action was suggested to me several years ago by the late Professor Charles Stewart.

When a Fish swims, lateral flexions, alternate from side to side, pass regularly down the body from head to tail. This is most manifest in such Fishes as the Eels and Dogfish, but in comparatively stiff fishes such as the Herrings the action is the same although the chief and most powerful flexion takes place when the wave of contraction nears the tail.

It is clear that the aorta will take part in these flexions—a swing to either side sweeping in regular sequence from head to tail (text-fig. 21, p. 203).

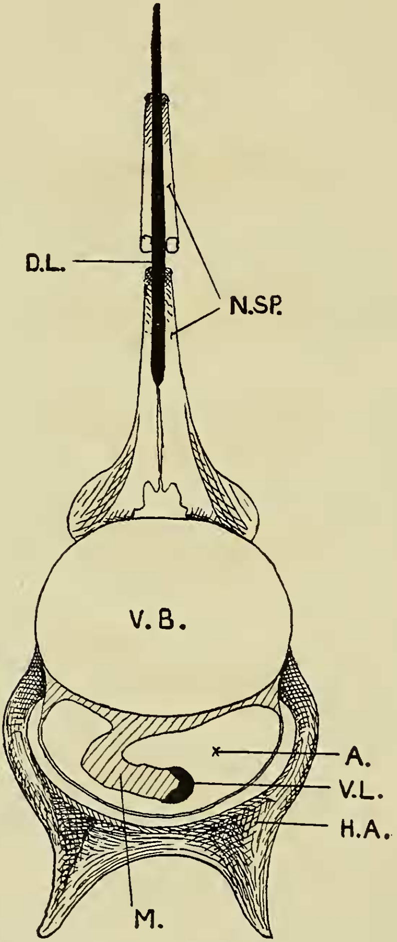
But the ventral ligament owing to its tension will remain practically stationary and will in effect form a series of diagonal curtains passing regularly in succession down the length of the aorta. Each curtain will of necessity push the blood before it.

The faster the fish swims the faster will become the blood stream in the aorta.

This ventral longitudinal ligament is found in, I believe, all

Herrings and also in the Sturgeons, and it is particularly interesting to note that in both these groups of Fishes the aorta has a similar character, being a wide capacious vessel enclosed

Text-fig. 20.



A transverse section through the vertebral column and aorta of a Shad, in the region of the trunk.

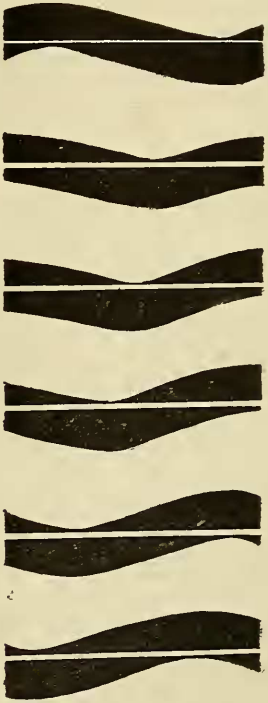
A. Aorta. D.L. Dorsal elastic ligament. H.A. Hæmal arch. M. Suspensory membrane of the ventral ligament. N.SP. Neural spines. V.B. Body of vertebra. V.L. Ventral ligament.

within a more or less complete skeletogenous and unyielding sheath. This is particularly so in the Sturgeon, where the vessel forms a closely adherent lining to a continuous cartilaginous canal.

In any case the aorta is to a great extent cut off from the direct effects of those internal movements and pressures to which in Fishes the arterial circulation is probably to a large extent due, as in the veins of Mammals.

We thus see in the case of these particular fishes the advantage of some special mechanism to aid the circulation of the blood.

Text-fig. 21.



Diagrams of one and the same portion of the aorta, showing the relative positions of the ventral ligament and aortic cavity during the lateral flexions of the body in swimming.

The ligamentum longitudinale is apparently formed around, though not actually from, the subchordal rod *—a structure that occurs as a transitory fœtal organ in Fishes and Amphibia, and from its mode of development appears to be the vestige of the epipharyngeal groove of *Amphioxus*.

---

* Franz, Morph. Jahrb. Bd. 25, 1897.

2. The framework, muscles, and ligaments of a gill-pouch of *Raja maculata*.

The expansion of the gill-pouch during the inspiratory movement is due to a series of elastic ligaments acting upon the branchial rays, drawing them away from the central member of the series.

3. An elastic modification of the anterior wall of the capsule of the costo-vertebral joints in a Python (*P. sebæ*).

This part of the capsule-wall is greatly thickened and consists almost entirely of elastic fibres arranged parallel to one another and to the long axis of the rib.

The action of this plate of elastic tissue would no doubt be to protract the rib upon the relaxation of its retractor muscles.

In Snakes forward locomotion is largely due to the forcible retraction of the ribs, their protraction being rather in the nature of a recovery to a state of repose—a movement requiring comparatively little force."

Dr. R. F. Scharff, B.Sc., F.Z.S., exhibited some long-bones and antlers of Reindeer from a cave in County Cork in Ireland.

He stated that Reindeer bones had been discovered sparingly in caves in the Counties of Sligo and Clare along with those of the Greenland Lemming (*Dicrostonyx torquatus*). During the Co. Cork cave explorations, the results of which will shortly be published in detail, Reindeer remains were found in extreme abundance. They were associated with the bones of Hyæna and two species of Lemming.

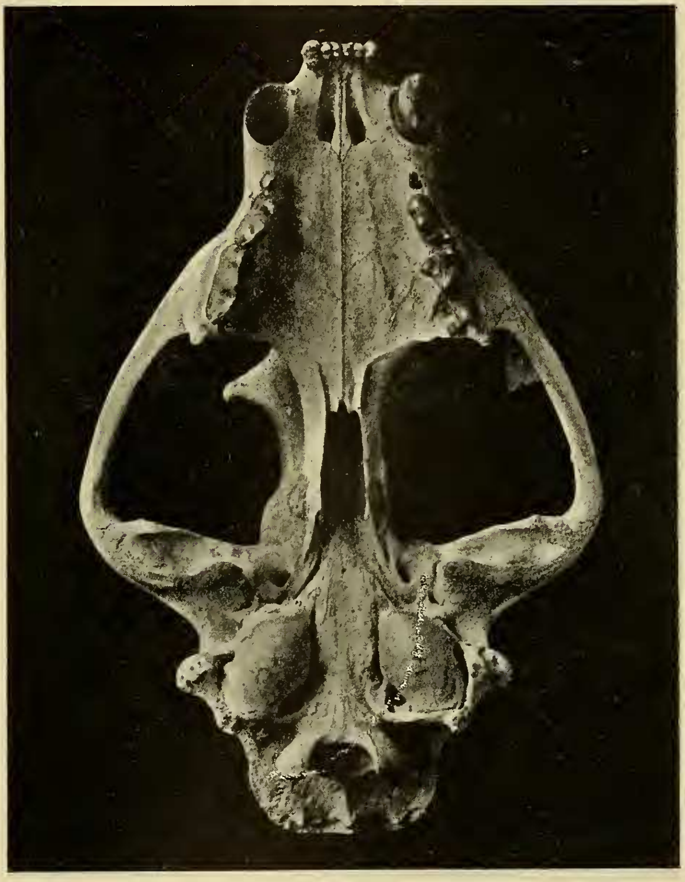
The main object of exhibiting the Reindeer bones was to draw attention to the fact that many of them showed distinct traces of having been gnawed by some other animal. Dr. Scharff had suggested that the tooth-marks might have been produced by young hyænas, but was disposed to accept the view that they were produced by Rodents. The marks on the antlers seemed to differ from those on the long-bones, the latter having often been gnawed through entirely in the middle.

Mr. Pocock on the Skulls of Leopards.

Mr. R. I. Pocock, F.L.S., F.Z.S., the Superintendent of the Gardens, exhibited the skulls of some West African Leopards which had come from Cette Cama in the Gaboon, and made the following remarks:—" I owe to Mr. Edward Gerrard, taxidermist, of Camden Town, the opportunity of examining these skulls, which he sent to me on account of their unusual size. He was struck by the fact that three of them surpass in dimensions all the Leopards' skulls out of the very large number that have passed through his hands, and are particularly remarkable for the length and thickness of the canine teeth. A comparison between their measurements and those cited in Rowland Ward's 'Records of

Big Game,' p. 500, 1907, shows that all three exceed both in length and width the largest therein recorded, the measurements of which were taken from an example from the North-Western Provinces of India. They also surpass in dimensions all the

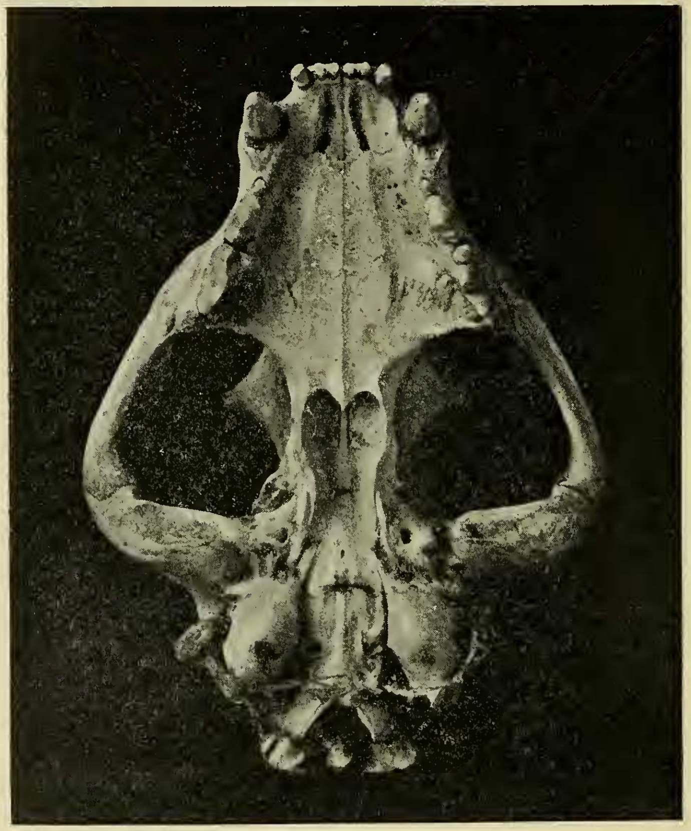
Text-fig. 22.



Skull of Leopard (*Felis pardus leopardus*) from Cette Cama. Ventral view. (No. 1 in table on page 208.)

Leopards' skulls I have seen in the collection of the British Museum and all those in the collection of the Society. Moreover, although their shape indicates very considerable development of the temporal muscles, the persistence of the divisional lines between the bones of the brain-case and the unworn character of the teeth show that they are not skulls of old Leopards, and suggest that they might have grown even larger if the animals had not been killed. In one indeed (No. 3) the occipital suture is still open. The locality proves practically beyond doubt that they belong to the tropical West African race of the Leopard (*Felis pardus*) which should be called *F. pardus leopardus* *.

Text-fig. 23.



Skull of Leopard (*Felis pardus pardus*) from Mhow, C.P., India. Ventral view. (No. 9 in table on page 208.)

From the largest Leopard's skull in the collection of the Society, they exhibit some very striking differences as the subjoined table of measurements shows (p. 208). This skull itself nearly reaches record dimensions since it exceeds in zygomatic width by half an inch the largest recorded by Rowland Ward ($7\frac{1}{8}$: $6\frac{5}{8}$) and falls only a quarter of an inch short of it in total length (10 : $10\frac{1}{4}$). It belonged to an exceptionally fine male from Mhow in the Central Provinces of India, presented to the Society by Mr. Pelham. This Leopard was of the typical race *F. pardus pardus*. Not only is this skull from Mhow broader across the premaxillæ than the Cette Cama specimens, but it also differs from them in having much smaller auditory bullæ, the width of these being less than the width of the basioccipital area between them, instead of being greater; but most of all does it differ in the width and shape of the mesopterygoid fossa, which is wider in front than behind and has a sinuous concavo-convex edge owing to the incurvature of the pterygoid bones; whereas this fossa in the Cette Cama skulls has almost parallel sides and is comparatively long and narrow though varying individually in these respects. It is also of interest to record that a Leopard's skull of average dimensions belonging to a male, presented to the Society by Mr. F. H. Melland and captured on the Luangwe River in North-east Rhodesia, has the mesopterygoid fossa shaped more like that of the specimen from Mhow than like the fossa of those from Cette Cama; and that in the equality in width between the auditory bullæ and the intervening area of the basioccipital, it occupies an intermediate stage. As I have already stated *, this Luangwe Leopard also differs from the typical West African form in colour, its yellow hue recalling that of most Indian specimens, although the spots are much smaller. This fact and the differences in the skull above recorded indicate that it represents a distinct subspecies from *F. pardus leopardus*; but in the present very unsatisfactory state of our knowledge of East and South African Leopards, I do not feel justified in applying to it a name, either new or old.

---

* Pocock, P. Z. S. 1907, p. 675.

Mr. Gerrard also sent to me with the three above mentioned skulls from Cette Cama, doubtless belonging to male specimens, a single skull of what I take to be a female animal, which was shipped from the same port at the same time together with some spoils of Gorillas and Chimpanzees. The closure of the cranial sutures shows that the specimen was adult and yet it is remarkably small, being 3 inches shorter and more than 2 inches narrower than the smallest of the three large ones (*cf.* measurements). This skull lends support to the oft-repeated statements of sportsmen that two kinds of Leopards, larger ones called Panthers and smaller ones called Leopards, occur in the same localities.

So far as size goes this small specimen approaches much nearer the typical skull of the dwarf Leopard of Somaliland described by Thomas as *F. pardus nanopardus*, a Leopard which, together with

---

* P. Z. S. 1907, p. 676.

	Cette Cama.				Luangwe River.	French Congo.	Fort Manning.	Somaliland. (*nanopardus*)	Mhow (India).
	1.	**2.**	**3.**	**4 (♀?)**	**5 ♂.**	**6.**	**7.**	**8.**	**9 ♂.**
Total length	$11\frac{1}{8}$	$10\frac{3}{4}$	$10\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{3}{4}$	$9\frac{1}{4}$	$9\frac{1}{8}$	$6\frac{3}{4}$	10
Basal length	9	$8\frac{7}{8}$	$8\frac{3}{4}$	$6\frac{1}{4}$	$7\frac{1}{8}$	—	—	—	$8\frac{3}{4}$
Length of palate (external to middle line)	$4\frac{1}{2}$	$4\frac{5}{8}+$	$4\frac{1}{2}$	3	$3\frac{5}{8}$	$4\frac{1}{8}$	4	—	$4\frac{1}{4}$
Width across zygomata	$7\frac{1}{8}$	7	$7\frac{1}{8}$	$4\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{7}{8}$	$5\frac{3}{4}$	$3\frac{7}{8}$	$7\frac{1}{8}$
„ between orbits	$1\frac{3}{4}$	$1\frac{7}{8}$	$1\frac{3}{4}$	$1\frac{1}{8}$	$1\frac{5}{8}$	$1\frac{1}{2}$	$1\frac{1}{2}$	—	$2\frac{1}{8}$
„ across postorbital processes	$3\frac{3}{8}$	$3\frac{1}{4}$	—	$2\frac{1}{4}+$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{5}{8}$	—	$3\frac{1}{2}$
„ behind ditto (waist)	$1\frac{5}{8}$	$1\frac{7}{8}$	$1\frac{5}{8}$	$1\frac{5}{8}$	$1\frac{3}{4}$	2	$1\frac{5}{8}$	—	$1\frac{1}{8}$
„ across parietals	$2\frac{7}{8}$	3	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{5}{8}$	—	—	—	$2\frac{5}{8}$
„ across maxillæ (outside canines)	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{5}{8}$	$1\frac{7}{8}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{4}$	—	$2\frac{3}{4}$
„ across premaxillæ (alveolar border)	1 −	1	1 +	$\frac{3}{4}$	$\frac{7}{8}$	1	$\frac{7}{8}$	—	$1\frac{1}{4}$
„ mesopterygoid fossa (at pal. pt. suture)	$\frac{9}{16}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{3}{4}$	—	1
„ outside ditto	$1\frac{3}{16}$	$1\frac{1}{4}$	$1\frac{5}{8}$	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{6}$	—	$1\frac{1}{2}$
„ of auditory bulla	$1\frac{1}{8}$	$1\frac{1}{16}$	1 +	$\frac{7}{8}$	$\frac{7}{8}$	1	1	$\frac{3}{4}$	1
„ between bullæ	$\frac{7}{8}$	$\frac{15}{16}$	$\frac{7}{8}$	$\frac{1}{2}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{5}{8}$	$1\frac{1}{8}$
Length of pm⁴	$1\frac{1}{16}$	$1\frac{1}{8}$	1	$\frac{7}{8}$	$\frac{7}{8}$	$1\frac{1}{8}$	1	$\frac{3}{4}$	1
„ canine	$2\frac{1}{8}$	$2\frac{1}{4}$	$1\frac{7}{8}$	$1\frac{3}{8}$	$1\frac{1}{4}$	—	$1\frac{5}{8}$	—	$1\frac{1}{2}$
„ ditto (enamel)	$1\frac{5}{8}$	—	—	—	$1\frac{1}{8}$	—	$1\frac{1}{8}$	—	$1\frac{1}{4}$
Width of canine (base)	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	—	$\frac{1}{2}$	—	$\frac{1}{2}$

its normal-sized congener coming from Somaliland, furnishes the most striking instance known of a larger and smaller form occurring in the same country.

In the subjoined table I have placed side by side for comparison measurements in English inches * of eight skulls of African Leopards and of one Indian example, namely, the above mentioned one from Mhow. Nos. 1–4 are the four examples from Cette Cama lent to me by Mr. Gerrard. No. 5 is Mr. Melland's Luangwe River small-spotted specimen. No. 6 is an example in the British Museum sent from the French Congo by Mr. G. L. Bates. Although smaller than the large Cette Cama skulls, this presents the same general features and has the mesopterygoid fossa narrow, with nearly parallel edges. No. 7 is a specimen from Fort Manning in Nyasaland, in the British Museum. Although considerably smaller than No. 3 of the Cette Cama series and larger than the Luangwe River example, this skull has the mesopterygoid fossa of the same actual width. The skull of another Leopard from Zomba in Nyasaland, however, has the mesopterygoid fossa broad, namely $\frac{1}{8}$ of an inch, that is to say very nearly as broad as in the considerably larger Indian example from Mhow. It will be seen therefore that the marked distinction in width and shape of the mesopterygoid fossa between Indian and West African Leopards breaks down in East and South African specimens, as is attested by the skull from Zomba, the one from Fort Manning, and also one from Cape Colony in the British Museum. The fossa in question is wide in all the Asiatic Leopards' skulls that I have seen, including specimens from India, North China (*F. pardus fontanieri*), Hong Kong, and of the Black variety from Malacca. It is also broad in the skulls of Jaguars (*F. onca*) and points to closer relationship, also borne out by the pattern, between Jaguars and Asiatic Leopards than between Jaguars and West African Leopards, a conclusion to be expected from geographical distribution. On the other hand, the anterior border of the fossa is at all events as a rule produced backwards into a sharply pointed angle in Asiatic Leopards, whereas in African Leopards it is generally at least markedly straighter, sometimes indeed slightly notched, and in Jaguars this edge is usually notched, as it is also in Lions.

In conclusion it may be said that Asiatic Leopards (*F. p. pardus*, *fontanieri*, etc.) have the mesopterygoid fossa wide, with arcuate lateral edges and the anterior edge strongly angled. West African Leopards (*F. p. leopardus*) have the mesopterygoid fossa narrower, with subparallel lateral edges and a straighter anterior border, whereas in East and South African animals some present one form of fossa and some the other; but I have not seen sufficient material to contribute anything further to the elucidation of the local races of Leopards, occurring between Abyssinia and Cape Colony.

---

* An English inch=25 mm.